Electronic Version
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Claims

[c1] We claim:

1. A control valve of a hydraulic brake booster for use in a brake system, said brake booster having a housing with a first bore therein for retaining a power piston, a second bore therein for retaining the control valve and an actuation chamber, said second bore being connected to a source of pressurized fluid, a reservoir and the actuation chamber, said control valve being responsive to an input force from an actuation arrangement for controlling communicating of pressurized fluid available from said source to said actuation chamber that acts on the power piston to effect a brake application and on termination of said input force for controlling communicating of the pressurized fluid present in said actuation chamber to said reservoir; said control valve being characterized by a first cylindrical body located in said second bore, said first cylindrical body having a first stepped axial bore that extends from a first end to a second end, said first stepped bore including a first diameter section adjacent said first end that is separated from a second diameter section by an orifice and a shoulder that separates said second diameter section

from a third diameter section adjacent said second end; said first diameter section being connected to said source of pressurized fluid while a first radial bore in said first cylindrical body connects said second diameter section with said actuation chamber and a second radial bore in said first cylindrical body connects said third diameter with said reservoir; a ball located in said first diameter section of said first cylindrical body and a first spring for urging said ball toward a seat adjacent said orifice to define a supply chamber for pressurized fluid within said second bore; a shuttle member that is retained in said second diameter section and having a stem on a first end thereof that is located near said orifice and an annular projection on a second end thereof that extends into said third diameter section of said first cylindrical body; a power piston retained in said second bore having an annular flange on a first end thereof that is located in said third diameter section of said first cylindrical body and a second end thereof that extends into said actuation chamber, said second cylindrical body has a second stepped axial bore that extends from said first end to said second end; a second spring that is located in said first stepped axial bore for urging said second end of said shuttle member thereon toward a first stop within said second bore to define a position of rest for said shuttle member; and a third spring located be-

tween said second end of said shuttle member and said first end of said power piston for urging said annular flange toward a second stop to define a position of rest for said power piston where said actuation chamber may freely communicate with said reservoir by way of said second stepped axial bore and said third diameter section and second radial bore in said first cylindrical body, said input force from said actuation arrangement on being applied to said second end of said power piston after overcoming the force said third spring moving said annular flange into engagement with said second end of said shuttle member to terminate communication to said reservoir through said second axial bore and thereafter overcoming the force of said second spring to move said stem into engagement with said ball and after overcoming the force of said first spring moving said ball off said seat to allow metered pressurized fluid to be communicated to said actuation chamber by way of said orifice, second diameter and said first radial bore to effect a brake application and on said input force being removed from said second end of said second cylindrical member said first spring moving said ball into engagement with said seat to termination communication of pressurized fluid through said orifice while said third spring moves said flange away from said second end of said shuttle member to meter flow of pressurized fluid second

present in said actuation chamber to said reservoir by way of said second axial bore in said second cylindrical member, said third diameter and second radial bore in said first cylindrical member.

[c2] 2. The control valve as recited in claim 1 wherein said metered pressurized fluid flow through said orifice increases in a substantially linear function during movement of said shuttle member by said input force applied to said second cylindrical member.

[c3] 3. The control valve as recited in claim 2 wherein said stem of said shuttle valve is characterized by a linear diameter surface that extends a first distance from said first end to a transition point and thereafter a conical diameter surface such that after the transition point passes through the orifice the space relationship between the conical diameter surface and the orifice creates said increases in the flow of pressurized fluid being supplied to said actuation chamber.

[c4] 4. The control valve as recited in claim 3 wherein said shuttle member is characterized by an annular rib located adjacent said second end, said annular rib engaging said shoulder on said first cylindrical member to limit the movement of said stem into said orifice and correspondingly the communication of pressurized fluid to

said actuation chamber.

[c5] 5. The control valve as recited in claim 4 wherein said second end of said shuttle member is characterized by an axial projection having a conical entry that transitions into a cylinder, said annular flange on said power piston being aligned with said conical entry to provide communication between said second stepped bore and said third diameter of said first cylindrical body such that metered pressurized fluid flows from said actuation chamber to said reservoir.

[c6] 6. The control valve as recited in claim 5 further characterized in that said annular flange engages said cylinder to seal said stepped axial bore from said third diameter on movement of said power piston by said input force.

[c7] 7. The control valve as recited in claim 5 wherein said first stop is characterized by a sleeve member located in said second bore, said sleeve having a length to set a distance between said conical entry and said annular flange to provide for open communication between said second stepped bore and said third diameter.

[c8] 8. The control valve as recited in claim 7 wherein said second stop is characterized by an annular spacer fixed within said second bore, said spacer being concentric

with said power piston and having a shoulder toward which said third spring urges said annular flange to assist in defining a flow path to permit open communication between said second stepped bore and said third diameter during periods of rest.

[c9] 9. The control valve as recited in claim 8 is further characterized by a second sleeve located within said spacer with a first end having a second flange thereon that is located between said first flange and said shoulder thereof and a second end located in a chamber within said spacer that is connected to a source of pressurized fluid.

[c10] 10. The control valve as recited in claim 9 wherein said second end of second sleeve responds to pressurized fluid by moving within said space to provide a force to move said first flange and correspondingly said shuttle member to effect a brake application.

[c11] 11. A control valve of a hydraulic brake booster for use in a brake system, said brake booster having a housing with a first bore therein for retaining a power piston, a second bore therein for retaining the control valve and an actuation chamber, said second bore being connected to a source of pressurized fluid, a reservoir and the actuation chamber, said control valve being responsive to

an input force from an actuation arrangement for controlling communicating of pressurized fluid available from said source to said actuation chamber that acts on the power piston to effect a brake application and on termination of said input force for controlling communicating of the pressurized fluid present in said actuation chamber to said reservoir; said control valve being characterized by a shuttle member that is sealingly retained in said second bore and having a stem on a first end that is located near an orifice through which pressurized fluid is communicated to said actuation chamber as a function of movement of said shuttle member and an annular projection on a second end; a cylindrical body retained in said second bore with a flange on a first end that is located in said second bore and a second end that is connected to said actuation chamber with an axial bore that extends from said first end to said second end; a first return spring for urging said second end of said shuttle member toward a first stop within said second bore to define a position of rest for said shuttle member; and a second return spring located between said shuttle member and said cylindrical body for urging said flange toward a second stop to define a position of rest for said cylindrical body where said actuation chamber is in free communication with said reservoir by way of said axial bore and said second bore, said input force from said

actuation arrangement on being applied to said second end of said cylindrical body and after overcoming the force said second return spring moving said flange into engagement with said annular projection of said shuttle member to terminate communication through said axial bore to said reservoir and thereafter overcoming the force of said first return spring moving said stem into said orifice and into engagement with a ball and then after overcoming the force of a valve moving said ball off a seat to allow metered pressurized fluid to be communicated to said actuation chamber by way of said orifice to effect a brake application and on said input force being removed from said cylindrical body said valve spring moving said ball into engagement with said seat to termination communication of pressurized fluid through said orifice while said first return spring moves said flange away from said annular projection on said shuttle member to meter flow of pressurized fluid second present in said actuation chamber to said reservoir by way of said axial bore such that flow of fluid is always in a same direction from said orifice toward said axial bore to attenuate the introduction of oscillatory forces into the shuttle member that may create noise.

[c12] 12. The control valve as recited in claim 11 wherein said stem of said shuttle valve is characterized by a linear di-

ameter surface that extends a first distance from said first end to a transition point of a conical diameter surface such that after the transition point passes through the orifice a space relationship between the conical diameter surface and the orifice creates an increases in the flow of pressurized fluid being supplied to said actuation chamber.

[c13] 13. The control valve as recited in claim 12 wherein said shuttle member is further characterized by an annular rib located adjacent said second end, said annular rib engaging a shoulder within said second bore to limit the movement of said stem into said orifice and correspondingly the communication of pressurized fluid to said actuation chamber.

[c14] 14. The control valve as recited in claim 13 wherein said annular projection is characterized by a conical entry surface that transitions into a cylinder surface, said flange on said cylindrical body being aligned with said conical entry surface such that a flow path occurs between said axial bore and said reservoir in said position of rest for said cylindrical body and metered pressurized fluid flows from said actuation chamber to said reservoir upon termination of a brake application.

[c15] 15. The control valve as recited in claim 14 further char-

acterized in that said flange engages said cylinder on said annular projection to seal said axial bore from said reservoir on movement of said cylindrical body by said input force.